

STUDIES ON THE PRESERVATION OF PLACENTAL BLOOD*

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THE first reference to the use of placental blood for transfusions is found in an article by Rubin⁷ which appeared in 1914. Later, reports of its successful use were published by Malinovsky and co-workers⁶ in 1934, Bruskin and Farberova³ in 1936, and Stavskaya¹¹ in 1937.

The present rather widespread use and investigation of the method followed the report of Goodall, Anderson, Altimas, and MacPhail⁴ in 1938.

The purpose of this present investigation is threefold: to ascertain again what are some of the normal constituents of placental blood, to determine whether there is a loss of intracellular potassium, and to compare the Russian preservative with the accepted sodium citrate solution.

METHODS

Potassium was analyzed by the modified argenticobaltinitrite procedure.^{8, 12} Cell volume was determined by the hematocrit.⁸ The specific gravity of plasma was measured by the falling drop technique of Barbour and Hamilton,² from which data the total plasma protein concentration was calculated.¹³ The normal values are presented in Table I.

TABLE I. NORMAL VALUES FOR PLACENTAL BLOOD

NUMBER	CELL VOLUME IN PER CENT	PLASMA SPECIFIC GRAVITY	PROTEINS GRAMS PER CENT	MILLIGRAMS PER CENT		
				PLASMA POTASSIUM	WHOLE BLOOD POTASSIUM	CELL POTASSIUM
1	53.9	1.0250	6.16	22.5	235	417
2	68.0	1.0261	6.53	21.3	279	400
3	66.0	1.0280	7.18	27.2	279	409
4	51.9	1.0250	6.16	26.4	225	408
5	50.1	1.0250	6.16	21.3	242	460
6	48.4	1.0231	5.51	26.2	208	401
7	51.5	1.0276	7.04	19.1	211	392
8	58.6	1.0264	6.63	23.7	227	370
Average	56.1	1.0258	6.42	23.5	238	407

In the first six experiments done in 1938, placental blood was mixed with various preservatives and tested. The plasma potassium ranged from 45 to 214 mg. per cent at the end of forty days. No conclusions could be made from this series.

Subsequently, the shape of the flask, the concentration of carbon dioxide, agitation, and hydrogen ion concentration, as well as the selection of the preservative, came to be appreciated as a few of the factors limiting potassium diffusion.⁸⁻¹⁰

With this added knowledge, a controlled experiment was carried out. Two identically shaped cylinders, with ground glass stoppers, capable of holding 42.8

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c.c. were used to collect the placental blood. In one, 21.4 c.c. of the I. H. T.* solution recommended by Goodall and his co-workers* was added to an equal quantity of blood. The anticoagulant was made up according to the formula of Bagdassarov¹ and consisted of sodium chloride, 7.0 Gm.; sodium citrate, 5.0 Gm.; potassium chloride, 0.2 Gm.; and magnesium sulphate, 0.004 Gm. in one liter of distilled water. In the other, 4.2 c.c. of a 3.5 per cent sodium citrate solution was added to 38.6 c.c. of blood to fill the container.

At the time of collection, a 5 c.c. portion was secured in an heparinized hematocrit tube. This served for the initial determination; its analysis revealed:

Hematocrit	{58.6% cells
	{41.4% plasma
Plasma specific gravity	1.0264
Total plasma proteins	6.63 Gm. %
Plasma potassium	23.7 mg. %
Whole blood potassium	227.0 mg. %
Cell potassium (calculated)	370.0 mg. %

After collection, the blood was stored in an electric refrigerator at 4° C. Samples were removed and tested with the results as tabulated in Table II.

TABLE II. COMPARISON OF OUTWARD DIFFUSION OF POTASSIUM IN PLACENTAL BLOOD STORED IN DIFFERENT PRESERVATIVES AT 4° C.

DATE	DAY OF STORAGE	MILLIGRAMS OF POTASSIUM IN PLASMA OF 100 C.C. OF BLOOD	
		I. H. T. SOLUTION	SODIUM CITRATE
8/17/39	0	9.8	9.8
8/19/39	2	33.4	32.5
8/26/39	9	68.9	55.9
9/ 2/39	16	88.6	57.1
9/ 9/39	23	107.5	77.2
Details of the experiment:			
Volume of cells		12.54	22.60
Volume of preservative		21.40	4.20
Volume of plasma		8.86	16.00
Total		42.80 c.c.	42.80 c.c.
Internal cylinder diameter: 1.8 cm.			

DISCUSSION

These findings indicate that the cell volume is approximately 22 per cent higher in placental blood than in that of the adult male; 37 per cent higher than in that of the adult female, and from 50 to 60 per cent higher than that of the reported average⁶ for mothers at term.

The specific gravity of the plasma and plasma proteins are approximately 10 per cent lower than the values found in normal adults.

The cell potassium is within normal limits, the whole blood values 25 per cent higher, and the plasma values 41 per cent higher than those found in adults.

CONCLUSIONS

1. The cell volume of placental blood is approximately 50 per cent higher than that of the mother, and 22 per cent higher than that of a normal adult male.

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2. The total proteins are less in placental blood than in normal adult blood.
3. The increase in concentration of plasma potassium ion is reconfirmed.
4. The rate of potassium diffusion from the placental blood cells is of the same order as adult blood.
5. These potassium diffusion studies indicate that a final concentration of 0.35 Gm. per cent sodium citrate in preserved blood is a superior preservative to the more complex Moscow I. H. T. solution.

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